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IMPACT OF PRE- EMERGENCE HERBICIDES FOR THE CONTROL OF WEEDS IN CHICK PEA (*Cicer arietinum L.*) UNDER HOT ARID CLIMATE.

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ABSTRACT

The experiments were conducted at Adaptive Research Farm Karor Lal Eason and farmers' field, i.e. Mouza Nawan Kot, Tehsil Choubara during Rabi 2014-15. The purpose of the experiment was to evaluate the effect of different herbicides for the control of weeds on chick pea.Two pre-emergence herbicides with two different doses, viz. Pendimethalin330 EC @ 2500 ml ha^{-1} before sowing, Pendimethalin330 EC @ 3750 ml ha^{-1}before sowing, Top Max 90% EC. (Metachlor 83% + Pendimethalin13%) @ 2250 ml ha^{-1} before sowing and TopMax 96% (Metachlor83% + 13%)@ 3350 ml ha^{-1}, were tested. An untreated plot was also included in the experiment. Fertilizer application (Nitrogen, Phosphorus,and Potash) and Cultural practices were according to the departmental recommendations.Weed control efficacy was better with higher doses of pre-emergence herbicides, i.e.Pendimethalin330 EC @ 3750 ml ha^{-1} and Top Max 96% (Metachlor 83% + Pendimethalin13%) @ 3350 ml ha^{-1}, as compared to lower doses of Pendimethalinand Top Max. It was also noted that high doses of pre-emergence herbicides increase number of branches per plant, number of pods/plant and grain yield.

Keywords: Pre- emergence herbicides, Chick Pea, (*Cicer arietinum* L.) Weed Control, Arid Zone and Pakistan.

INTRODUCTION

Chick pea (*Cicer arietinum L.*) is one of the important conventional pulse crops in Pakistan. Among pulses, it alone contributes 75 percent to total pulses grown in Pakistan.Chick pea (*Cicer arietinum L.*) is the most demanded legumes crop of this region, therefore grown in India, Pakistan, Turkey, Sudan, Sri Lanka and Bangladesh. In Pakistan total area of chickpea was 960-thousand hectares with an annual production of 484 thousand tones (Anonymous 2014-15Economic Survey of Pakistan). The chickpea yield is lower as compared to the maximum potential of cultivars. One of the limiting factors is weed infestation. Chickpea is a poor competitor to weeds because of its slow growth rate and limited leaf area development at the early stages of crop growth and establishment (Solh and Pala, 1990). Yield losses due to weed competition vary considerably depending on the level of weed infestation and weed species prevailing. Tewari *et al.* (2001) observed a reduction of 80% in chick pea when weeds were allowed to compete for full season.

The major weeds of chick pea in irrigated areas of the mixed cropping zone of Punjab are *Chenopodium album*, *Chenopodium murale*, *Fumaria indica*, *Rumex dentatus*, *Vicia sativa* and *Avena fatua*. In Pakistan, weeds reduce chickpea yields by 24-63% (Tanveer *et al.*, 1998). Potential yield losses in chick pea due to weeds range between 22-100% (Sexena and

Yadav, 1976). Bhalla *et al*. (1998) reported that the herbicide treatment gave a rate of 50-54% weed control in chickpea. Hassan and Khan (2007) reported an increase of 12-14% by pre-emergence and 6-23% by post-emergence herbicides in a chickpea crop. Weeds affect growth, yield and quality of crop plants adversely and reduce soil fertility. They compete with the crop plants for soil moisture, nutrients, space and sunlight. Considerable yield losses in chickpea were recorded to the extent of 88% if weeds are not controlled within critical growth period of crop (Bhalla *et al*., 1998).

Weed emergence with the Rabi sown Chickpea crop creates a severe competition unless controlled effectively and in a timely manner. Inter-row cultivation is not sufficient and inter-row hand weeding is necessary under most conditions. There is an urgent need to move from the costly manual mechanical weed control to chemical weed control (Marwat *et al*., 2003).

Therefore, the present study was undertaken to test the efficacy of pre and post-emergence herbicides and to find the most environment friendly, safe and economical herbicides to control weeds around the chick pea.

MATERIALS AND METHODS

Location

The experiments were conducted at Adaptive Research Farm Karor Lal Eason, District Layyah and farmers' fields Mouza Nawan Kot, Tehsil Choubara, during Rabi Crop Season 2014-15. The chickpea variety, Bhakkhar-11 was sown 25 kg ha^{-1} in 1st week of November with single row cotton drill. The experiments were comprised of 5 treatments replicated thrice using a Randomized Complete Block Design (RCBD).

Treatments

The plot size was 1.5 x7 m^2 comprising 30 cm apart rows.Two pre-emergence herbicides with two different doses viz. T_2=Pendimethalin330 EC @ 2500 ml ha^{-1} before sowing, T_3-Pendimethalin330 EC @ 3750 ml ha^{-1} before sowing, T_4=Top Max 90% EC (Metachlor 83% + pendimethlin13%)@ 2250ml ha^{-1}before sowing, and T_5= Top Max 96% EC (Metachlor 83% + Pendimathaline13%)@ 3350 ml ha^{-1} before sowing, were tested as pre-emergence herbicides for narrow and broad leaves weeds . An untreated plot (T_1) was also included in these experiments.

Nutrients

Nutrients such as Phosphorus, Nitrogen and Potash were applied in form Diammonium Phosphate (DAP), urea and sulphate of potash (SOP) at the time of sowing, as per recommendations. All other Agronomic practices were kept uniform in all the treatments.

Parameters

The data recorded weed density, number of branches per plant, number of pods per plant, 100-grains weight and grain yield kg/ha.

Statistical Analysis

Year wise data was subjected to statistical analysis separately by using analysis of variance technique. The data on individual traits were subjected to ANOVA and significant means were separated by using LSD test at 5 percent probability level (Steel and Torrie, 1980).

RESULTS

Germination m^{-2}

The results given in Table 1 and 2 showed that all the herbicides have no impact on germination m^{-2} in gram crops in both locations, i.e. at Adaptive Research Farm Karor, as well as Farmers' field at

Table 1: Effect of pre-emergence herbicides for the control of weeds in Chick pea *location-I.*

Treatments with description	Germination m^2	No. of weeds before spray.	No. of weeds after spray.	No. of branches $plant^{-1}$	No. of pods $plant^{-1}$	100- grains weight	Yield (Kg ha^{-1})
T_1	21 a	59.40 a	136.33 a	4.8 c	32.03 b	19.33 b	270.49 c
T_2	22 a	63.8 a	11.0 b	5.2 ab	36.0 a	21.33 a	367.59 b
T_3	24 a	60.5 a	6.0 bc	5.4 a	36.5 a	22.0 a	371.0 a
T_4	23 a	65.3 a	11.0 b	5.13 b	35.33 a	22.33 a	368.6 b
T_5	25 a	69.1 a	5.0 b	5.43 a	35.96 a	22.66 a	371.09 a

T_1= control, T_2=pendimethalin330 EC2500 ml ha^{-1}, T_3=pendimethalin330 EC 3750 ml ha^{-1}, T_4 =Topmax 90% EC @ 2250 ml ha^{-1}, T_5 =Topmax 96% EC @ 3350 ml ha^{-1}

Meansof three replications in the columns followed by different letters are significantly different at 5% level of probability, using LSD.

Table 2: Effect of pre-emergence herbicides for the control of weeds in Chick pea *location-II.*

Treatments with description	Germination m^{-2}	No. of weeds before spray.	No. of weeds after spray.	No. of branches $plant^{-1}$	No. of pods $plant^{-1}$	100-grains weight	Yield (Kg ha^{-1})
T1	22 a	60.50 a	69.33 a	4.73 b	32.0 c	19.66 c	412.54 c
T2	23 a	62.6 a	11.0 b	5.16 a	36.11 a	20.33 bc	507.06 b
T3	25 a	61.5 a	6.0 bc	5.4 a	36.7 a	20.66 ab	521.88 a
T4	24 a	64.6 a	11.0 b	5.13 ab	34.76 b	21.66 c	511.08 b
T5	26 a	68.5 a	5.0 c	5.4 a	35.4 ab	22.0 a	522.72 a

T_1= control, T_2=pendimethalin330 EC2500 ml ha^{-1}, T_3=pendimethalin330 EC 3750 ml ha^{-1}, T_4 =Topmax 90% EC @ 2250 ml ha^{-1}, T_5 =Topmax 96% EC @ 3350 ml ha^{-1}

Means of three replications in the columns followed by different letters are significantly different at 5% level of probability, using LSD.

Mouza Nawan Kot, Tehsil Choubara. The analysis of data regarding germination at Adaptive Research Farm Karor (Table 1) showed that maximum germination was found in T_5 (25) Top Max 96% EC (Metachlor 83% + Pendimethalin13%) @ 3350 ml ha^{-1} was going to be applied, followed by T_3 (24), T_4 (23) and T_2 (22) where Pendimathaline330 EC @ 3750 ml ha^{-1}, Top Max 90% EC (Metachlor 83% + pendimethlin13%) @ 2250ml ha^{-1} and Pendimethalin330 EC @ 2500 ml ha^{-1} were going to be applied respectively. The least number of plant populations (21) was found in check plot where no herbicides were applied. Data concerning germination at Mouza Nawan Kot, Tehsil Choubara showed similar trend of results as those studied at Adaptive Research Farm Karor.

No. of weeds before spray

The data regarding the number of weeds before spraying indicated no significant difference was found among all the treatments in both locations, i.e. Adaptive Research Farm Karor and Farmers'field (Table 1 and 2). The comparative mean of study at Adaptive Research Farm,Karor elaborated that maximum number of weeds (69.1) was found in T_5 where Top Max 96% EC (Metachlor 83% + Pendimethalin13%) @ 3350 ml ha^{-1} was applied, followed by T_4 (65.3), T_2 (63.8) and T_3 (60.5) where Top Max 90% EC (Metachlor 83% + pendimethlin 13%) @ 2250ml ha^{-1}, Pendimethalin 330 EC @ 2500 ml ha^{-1} and Pendimethalin 330 EC @ 3750 ml ha^{-1} were applied respectively, whereas, least no. of weeds (60.5) was found in check plot where no herbicides were applied. Data concerning no. of weeds before spray at Mouza Nawan Kot, Tehsil Choubara showed similar trend of results as such studied in Adaptive Research Farm Karor (Bhalla *et al*., 1998).The lowest numbers of pods were obtained from plots where the crop was kept weedy throughout the growing period and was due to severe weed competition for resources, nutrients, moisture, light and space.

No. of weeds after spray

All the pre-emergence weedicides reduced the weeds population compared to that in a control plot, but Top Max 96% EC (Metachlor+Pendimethalin13%) @ 3350 ml ha^{-1} before sowing consistently proved better than other treatments during Rabi 2014-15at Adaptive Research Farm Karor Lal Eason as well as Farmers' fields in Mouza NawanKot, Tehsil Choubara (table 1).

The above mentioned two locations' data shows that all the weedicides were equally effective for controlling weeds in both locations and severely suppressed the weeds population as pre-emergence weedicides of gram crop Adaptive Research Farm Karor. The data regarding the no. of weeds after spraym^2 showed that no significant difference was found among the treated plots as compared to that in control plot (Table 1). Comparative study of means showed that minimum no. of weeds after spray (5.0) were counted in T5, where Top Max. 96% (Metachlor and Pendimethalin 13%) @ 3350 ml h^{-1} was applied as pre-emergence weedicides, followed by T_3 (6.00) where Pendimethalin330 EC @ 3750ml ha^{-1} was applied. The equal no. of weeds after spray(11.0) were counted in T_2 and T_4, where Pendimathline 330 EC@ 3750 ml ha^{-1}before spray and Top Max90% EC (Metachlor 83% and Pendimethaline 13%) @ 2250 ml ha^{-1} before spray were applied. The maximum nos. of weeds (136.33) was found in check plot. The data concerning the no. of weeds/m^2 at Mouza Nawan Kot, Tehsil Choubara showed similar trend as those studied in Adaptive Research Farm Karor. Haqqani and Riaz (1989) reported that hand weeding controlled only by 17% both years because

labour intensive strategy is even beyond the reach of resource poor farmer.

No. of Branches plant^{-1}

The analysis of data regarding the number of branches per plant in Adaptive Research Farm Karor Lal Eason (Table 1) showed significant differences among all the treatments under study. The comparative study of means showed that maximum number of branches after spray(5.43) per plant was achieved in $T_5$where Top Max 96% (Metachlor + Pendimethalin13%) @ 3350 ml ha^{-1} was applied, followed by the T_3 (5.4) where Pendimethalin330 EC @ 3750 ml ha^{-1} was applied, as compared to control (4.8) in $T_1$where no herbicides were applied. The intermediate number of branches were recorded in T_2 (Pendimethalin330 EC)@ 2500 ml ha^{-1}and T_4Top Max 90% EC (Metachlor + Pendimethalin13%) @ 2250ml/hahaving 5.2 and 5.13 branches per plant respectively. The data concerning the no. of branches per plant in Mouza Nawan Kot, Tehsil Choubara showed similar trend as studied in Adaptive Research Farm Karor.

No. of pods plant^{-1}

Data pertaining the number of pods per plant in Adaptive Research Farm, Karor Lal Eason and indicated no significant difference among the different herbicidal treatments under the study (table 1). The comparative study of means showed that maximum number of pods per plant 36.5 was achieved in T_3 where Pendimethalin330 EC @3750ml ha^{-1} was applied, followed by the T_2 (36.0), T_5(35.96) and T_4(35.33), pendimethalin330 EC @ 2500 ml ha^{-1},Top Max 96% EC (Metachlor 83% + pendimethalin13%) @ 3350 ml ha^{-1}and Top Max 90% EC(Metachlor 83% + pendimethlin 13%) @ 2250ml ha^{-1}) were applied respectively. The minimum number of pods per plant (32.03) was obtained in check plot. Data regarding the number of pods per plant in Mouza Nawn Kot, Tehsil Choubara showed similar trend as studied in Adaptive Research Farm, Karor. Bhan *et al*. (1987) reported that effective control of weeds led to direct increase in uptake of nutrients and thereby, proper growth and development of crop, which resulted in maximum number of pods per plant and test weight ultimately resulting in increased seed yield.

100-Grain Weight

The data regarding the 100-grain weight in Adaptive Research Farm,Karor Lal Eason (table 1) showed that no significant difference was found among the different herbicidal treated plots. Maximum 100-grain weight (22.66 gm) was recorded in T_5 where Top Max 96% (Metachlor+ Pendimethalin13%) @ 3350 ml ha^{-1} was applied, followed by T_4 (22.33), T_3 (22.0) and T_2 (21.33), where Top Max 90% EC (Metachlor + pendimethlin 13%) @ 2250 ml ha^{-1} Pendimethalin330 EC @ 3750 ml ha^{-1} and Pendimethalin330 EC @ 2500 ml ha^{-1} were applied respectively. Minimum 100 grain weight (19.33) was obtained from check plot. The recorded yield data illustrated that similar trend regarding the 100-grain weight was also found inMouza Nawan Kot, Tehsil Choubara and at Adaptive Research Farm,Tehsil Karor, District Layyah.

Yield (kg ha^{-1})

The analysis data concerning the grain yield in Adaptive Research Farm, Karor Lal Eason showed significant differences among the different treatments as presented in table1. A comparative study of the means showed that maximum yield (371.09 kg ha^{-1}) was achieved in T_5, where Top Max 96% (Metachlor + Pendimethalin13%) @ 3350ml ha^{-1} was applied. It was statistically similar with T_3 (Pendimethalin330 EC @ 3750 ml ha^{-1}) with grain yield of 371.0 kg ha^{-1}. The

intermediate treatment were statistically at par with treatment T_2(Pendimethalin330EC @ 2500ml ha^{-1}) and T_4 Top Max 90% EC (Metachlor83% + pendimethlin 13% @ 2250ml ha^{-1}) with grain yield of 367.59 and 368.6respectively. The minimum grain yield of 270.49 was obtained from control plot where no weedicides were applied (Table 1).

DISCUSSION

Upadhyay and Bhalla (2002) also reported higher seed yield under manual weeding treatment.The recorded yield data illustrated that similar trend regarding the grain yield was also found in Mouza Nawan Kot, Tehsil Choubara as was studied in Adaptive Research Farm, karor.Yadav and Singh (1988) reported that Tribunal at 0.75 kg and 1.50 kg ha^{-1} provided the highest yield from chemical control. Marwat *et al.* (2011) reported that weed control significantly increased the plant height of crop due to less weed-crop competition. Althahabi *et al.* (1994) concluded that weeds reduce pods per plant in chickpea. Hassan *et al*. (2003) and Marwat *et al.* (2004) reported increase in chickpea yields with the use of herbicides. Integration of herbicide application in agronomic practices is not acceptable to thefarming community in the area under study because the weeds are the only source of animal feed in the area under discussion. Therefore, recommendations of manual weeding at early growth stages of the crop are not only acceptable to the farmers, but are also economica land safe.

Hassan *et al.* (2010) reported that weed infestation, economic status of the farmers and poor management practices are the major production constraints in the southern distracts of Khyber Pakhtunkha(KPK). The area under discussion is totally dependent on the rainfall that prevails during the winter.Therefore, the farmers usually do not take interest in weed control and other practices. However, sometimes due to excessive rainfall, the weed growth occursvigorously and thus,out competes the chickpea crop. Proper training of the farmers is needed not only to train in herbicide application, but also to educate them about the possible negative effects of weeds on the chickpea grain yield. There are bright chances of organic chickpea production due to absence of pests and easy control of weeds because the farm produce is directly consumed by the farmers at home.

CONCLUSION

From the results of both locations, i.e. Adaptive Research Farm, Karor Lal Eason and Mouza Nawan Kot, Tehsil Choubara, it is clear that higher doses of Pendimethalin330 EC @ 3750 ml $ha^{-1}$and Top Max 96% (Metachlor 83% + Pendimethalin13%) @ 3350 ml ha^{-1} are the most effective pre-emergence herbicides for weed control in gram and increased gram yield and also yield parameters such as number of branches per plant and number of pods per plant.Pre-emergence herbicides is also increasing in Pakistan as compared to post emergence herbicides.

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